

REMARKS/ARGUMENTS:

Claim 8 is canceled without prejudice. Claim 1 is amended. Claims 1-3, 5-7, and 9-12 are pending in the application. Reexamination and reconsideration of the application, as amended, are respectfully requested.

The present invention relates to a substrate for thin film solar cells, a method for manufacturing the same, and thin film solar cells therewith. (Applicant's specification, at p. 1, lines 6-8).

CLAIM REJECTIONS UNDER 35 U.S.C. § 103:

Claims 1-3, 5, and 7 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tawada (JP 2003243676) in view of Matsui (*Influence of substrate texture on microstructure and photovoltaic performance of thin film polycrystalline silicon solar cells*). Applicant respectfully traverses this rejection. Claim 1 was amended to include all the limitations of canceled claim 8. Claims 8-11 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tawada in view of Matsui as applied to claim 1, above, and further in view of Robinson et al. (U.S. Patent Application Publication No. 20050238871). Claim 1, as amended, is as follows:

A substrate for thin film solar cells consisting of a transparent insulating substrate, and a transparent electrode layer including at least zinc oxide deposited on the transparent insulating substrate,  
wherein the transparent insulating substrate has a fine surface unevenness having a root-mean-square deviation of the surface of 5 to 50 nm in an interface by a side of the transparent electrode layer, and  
a projected area consists of a curved surface,

wherein the transparent insulating substrate consists of stacked layer of a transparent base material having a smooth surface, and a transparent foundation layer, and the transparent foundation layer comprises transparent micro-particles having an average particle diameter of not less than 10 nm and not more than 95 nm, and a transparent binder.

Applicant respectfully submits that Tawada, Matsui, and Robinson cannot render claim 1 obvious, because the combination of references fails to teach or suggest "transparent micro-particles having an average particle diameter of not less than 10 nm and not more than 95 nm."

It is an aspect of the present invention that with respect to the transparency of the material, or affinity with glass plate, silica micro-particles are preferable. In order to obtain 5 to 50 nm of a root-mean-square deviation of the surface of surface unevenness in the transparent foundation layer 112, a particle diameter of the micro-particles to be used is preferably not less than 10 and not more than 95 nm. In order to uniformly form the finest possible unevenness, the micro-particles have preferably a spherical shape. (Applicant's specification, at p. 20, lines 18-26).

The Office at p. 7, lines 8-14 of the Office Action states,

"Regarding claims 8-11, Tawada in view of Matsui teach the transparent microparticles having an average diameter of 0.1 to 1.0 microns. However, it is known in the art to create a substrate containing silica microparticles (such as those used in modified Tawada) with particles having an average diameter of 5 to 25 nm, thus creating an improved surface of the substrate for thin film solar cells and other devices, as taught by Robinson (abstract, [0012]-[0018] and [0025])."

Applicant respectfully disagrees. As acknowledged by the Office, Tawada teaches an average diameter of 0.1 to 1.0 microns. Therefore, the entire range of

Tawada is outside of the range of the present invention. Consequently, Tawada teaches away from the present invention.

“A prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention.” MPEP 2141.02

Therefore, without the benefit of the Applicant's disclosure, there would have been no incentive or reason for one of ordinary skill in the art to arrive at a transparent foundation layer that comprises transparent micro-particles having an average particle diameter of not more than 95 nm.

The Office at p. 8, lines 16-22 of the Office Action states (in Response to Arguments filed 3/10/2009),

“Applicant argues that ‘Tawada teaches away from the average diameter of less than 100 nm’ (pp 8 of Arguments). The Examiner notes that though Robinson is relied upon to teach average diameters less than 100 nm. The teachings of Tawada provide the structural elements of the device but fail to disclose an average particle size of less than 100nm. However, one of ordinary skill in the art would have looked to the prior art (i.e. Robinson) when determining the particle size in such a device.”

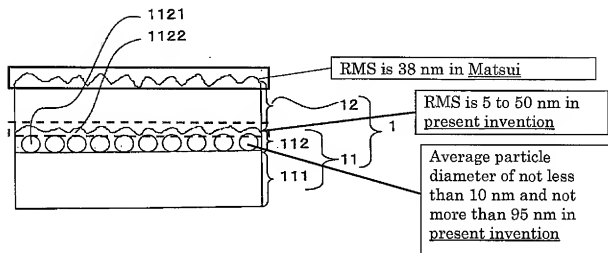
In response, Applicant respectfully submits that the Office has failed to present an adequate showing as to why Tawada's teaching of an average diameter of 0.1 to 1.0 microns should be ignored in favor of Robinson's teaching of an average diameter of 5 to 25 nm, particularly, in view of the Office's acknowledgment that Tawada provides the structural elements of the device. Furthermore, as discussed above, references must be considered in their entirety including portions that would lead away from the claimed invention.

And since Robinson fails to teach or suggest the structural elements of the device, Applicant fails to see the rationale for using Robinson's average diameter of 5 to 25 nm.

In addition, Robinson employs colloidal silica having a particle size of about 5-25 nm so that surface smoothness is improved (see e.g., Robinson, paragraphs [0018] and [0025]). In contrast, a purpose of Tawada is to have an uneven surface to provide a larger light confinement (light trapping) effect. In this respect, Robinson and Tawada have opposite goals. Consequently, a person of ordinary skill in the art would not be motivated to combine these two references.

Furthermore, with respect to Matsui, the Office asserts that utilizing a textured substrate with a RMS roughness of 38 nm to improve the conversion efficiency is known (Office Action, at p. 4, lines 20-23). However, as discussed above, Matsui mentions the RMS value of 38 nm on the ZnO layer, not on the transparent foundation layer below ZnO layer as shown in the figure below. The surfaces disclosed in Matsui are different than the surfaces of the present invention. Stated differently, Matsui teaches the unevenness of the ZnO layer but is silent as to the unevenness of the transparent foundation layer.

Therefore, the combination of cited references fails to teach or suggest that "the transparent insulating substrate has a fine surface unevenness having a root-mean-square deviation of the surface of 5 to 50 nm in an interface by a side of the transparent electrode layer."



Furthermore, as described at paragraph [0041] of Applicant's specification, the translucent micro-particles 1121 form unevenness in the translucent foundation layer 112, and can vary growth of a film of the transparent electrode layer 12 deposited thereon. That is, the unevenness of the transparent insulating substrate (translucent foundation layer) does not directly reflect the unevenness of the ZnO transparent electrode layer, but instead affects the growing state (form) of ZnO. Therefore, the optimal unevenness ranges of the insulate substrate (described in present invention) and the transparent electrode layer (described in Matsui) are not the same.

In addition, whether an uneven surface is in the light incident side or in the back side produces different technical effects. If the surface of the light incident side is uneven, the incident light is scattered when it transmits the uneven surface and thus a light confinement effect can be achieved. In contrast, as disclosed in Matsui, if the surface of the back side is uneven, the light is reflected at the uneven

surface and then scattered. Therefore, the optimal unevenness ranges for the light incident side and for the back side cannot be the same.

The Office notes, at p. 8, lines 11-12 of the Office Action, that the instant claims do not require the placement of the transparent substrate on the front side or the backside of the solar cell. However, as discussed above, Matsui's reflective substrate is not a transparent insulating substrate, and cannot be used for the substrate on the light incident side. In contrast, the present invention requires that both the insulating substrate and the electrode layer be transparent, which means the adoption for the light incident side.

In view of the foregoing, Matsui does not render the feature "the transparent insulating substrate has a fine surface unevenness having a root-mean-square deviation of the surface of 5 to 50 nm in an interface by a side of the transparent electrode layer" obvious.

Moreover, the Office notes at p. 8, lines 13-15 of the Office Action, that the modified Tawada reference teaches the structural limitation of the instant claims. However, as evident from Figures 1 and 2 of Tawada, the transparent insulating substrate (1) is disposed on the light incident side, and therefore, Tawada's transparent substrate cannot be modified with Matsui's non-transparent reflective substrate.

In light of the foregoing, Applicant respectfully submits that the cited references cannot render claim 1 obvious, because the cited references fail to teach or suggest each and every claim limitation. Claims 2, 3, 5, 7, and 9-11 depend from claim 1 and therefore, cannot be rendered obvious for at least the same reasons as claim 1. Withdrawal of this rejection is thus respectfully requested.

Claim 6 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Tawada in view of Matsui as applied to claim 1, above, and further in view of

Oswald et al. (U.S. Patent Application Publication No. 20030116185). Applicant respectfully traverses this rejection.

Claim 6 depends from claim 1 and cannot be rendered obvious over Tawada and Matsui for reasons discussed above. Oswald cannot remedy the defect of Tawada and Matsui and is not relied upon by the Office for such. Instead, the Office cites Oswald for teaching that it is known in the art to introduce isolation grooves/gaps into the back electrode and photoelectric layers of a photoelectric device to separate and electrically isolate adjacent back electrodes; and for teaching a later series connection of the separated photoelectric conversion cells, requiring connection grooves.

In light of the foregoing, Applicant respectfully submits that the cited references cannot render claim 6 obvious, because the cited references fail to teach or suggest each and every claim limitation. Withdrawal of this rejection is thus respectfully requested.

Applicant believes the foregoing amendments comply with requirements of form and thus may be admitted under 37 C.F.R. § 1.116(b). Alternatively, if these amendments are deemed to touch the merits, admission is requested under 37 C.F.R. § 1.116(c). In this connection, these amendments were not earlier presented because they are in response to the matters pointed out for the first time in the Final Office Action.

Lastly, admission is requested under 37 C.F.R. § 1.116(b) as presenting rejected claims in better form for consideration on appeal.

In view of the foregoing, it is respectfully submitted that the application is in condition for allowance. Reexamination and reconsideration of the application, as amended, are requested.

Appl. No. 10/588,708  
Amdt. Dated August 20, 2009  
Reply to Final Office Action of June 22, 2009

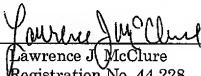
Attorney Docket No. 81844.0052  
Customer No.: 26021

If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Los Angeles, California telephone number (310)785-4600 to discuss the steps necessary for placing the application in condition for allowance.

If there are any fees due in connection with the filing of this response, please charge the fees to our Deposit Account No. 50-1314.

Respectfully submitted,  
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